1. INTRODUCTION

This report describes the results of a study to investigate program implementation scenarios that would reduce annual program expenditures without delaying the start of waste acceptance. The "reference program implementation scenario" for this study is the implementation scenario for the current program approach. The current program approach begins receipt and emplacement of waste in 2010. All surface facilities are constructed by the time waste receipt starts (CRWMS M&O 1997). The subsurface infrastructure for a full-scale repository, including two independent ventilation systems, is also completed prior to initial emplacement operations. However, only a portion of the waste emplacement drifts (approximately 10 percent) would be excavated by 2010. Construction of additional emplacement drifts continues concurrent with receipt and emplacement of the waste. Construction of a Nevada branch rail line to the repository is also complete when waste receipt starts in 2010.

Another study (CRWMS M&O 1998) examined how receipt of spent fuel at the repository as early as 2007 could be achieved by completion of selected surface facilities after receipt of construction authorization in 2005. Such early receipt could serve National needs in at least three ways: (1) accelerate fulfillment of DOE's obligation to begin accepting commercial SNF, (2) reduce the need for new utility dry storage sites, and (3) reduce the need to store SNF at shutdown reactors. It could also accelerate DOE's commitment to remove naval SNF and other DOE SNF from Idaho before 2035. Required annual funding, however, would be increased over that of the current program implementation scenario if construction of the Nevada transportation infrastructure and all reference program repository facilities were to be completed before 2010.

This report describes the analysis of program implementation scenarios that begin waste receipt in 2010, and implementation scenarios that begin early receipt at the repository surface facilities in 2007 or 2008. The scenarios were formulated to achieve reduced annual funding requirements through utilization of modular surface and subsurface facility construction, selection of annual receipt rates, and selection of the mode for transportation of large casks to the repository. program implementation scenarios, other than the reference program scenario, have capabilities for receiving waste that differ from the capabilities of the reference program scenario. In some cases, these scenarios also would incur risks that would not be incurred by the reference implementation scenario. This report describes the differences between the capabilities and risks of the reference program scenario and each alternative implementation scenario.

The study considered receipt and emplacement of the wastes currently identified to be disposed of by the reference program scenario through 2020. Those wastes include commercial SNF, naval SNF, DOE SNF, canisters of high-level waste with immobilized plutonium, and canisters of high-level waste without immobilized plutonium.

All analyses of CRWMS effectiveness in this report measure the ability of the CRWMS to pick up waste and meet National needs. "Effectiveness" does not refer to the waste isolation total system performance assessment (TSPA). TSPA for post-closure waste isolation would not be affected by any of the implementation scenarios since the configuration of the final repository in each of the scenarios is the same as the reference design.

1.1 GROUND RULES AND ASSUMPTIONS

The ground rules and assumptions described in this section were applied to the development and analysis of each of the program implementation scenarios.

The following ground rules and assumptions apply to waste acceptance:

- The commercial SNF acceptance rates given by the Annual Capacity Report (ACR) (DOE 1995) are the minimum considered. The rates for the first 2 years of acceptance are 400 MTHM per year and 600 MTHM per year respectively. The rates for the next 8 years are 900 MTHM per year. The oldest-fuel-first (OFF) algorithm is used to prioritize waste acceptance at the rates given in the ACR. It is assumed that the utilities might request that priorities for waste acceptance in excess of the ACR rates would be given to sites with shutdown reactors, reactors with impending needs for new dry storage sites, and reactors with impending needs to place more SNF in existing dry storage sites.

- Receipt of waste at the repository in 2007, before the CRWMS can emplace waste underground, is assumed to be permitted with authorization for construction, and is assumed not to require new authorizing legislation. It is expected that changes to 10 CFR Part 60 would be needed to provide for receipt of waste before subsurface facilities are constructed and licensed. Completion of any required regulatory changes to 10 CFR Part 60 is assumed to be feasible in sufficient time to support receipt at the repository surface facilities in 2007.

- Shipment of naval reactor fuel is assumed to start in the first year that commercial SNF is accepted. The maximum rates of shipment, shown in Section 5, Table 5-1, are those assumed in the *Department of Navy Final Environmental Impact Statement for a Container System for the Management of Naval Spent Nuclear Fuel* (Department of Navy 1996, page 7-3) for multi-purpose canisters.

- Shipment of canisters of high-level waste with immobilized plutonium is assumed to start in 2010. Sufficient high-level waste without immobilized plutonium is shipped so that waste packages containing two canisters of high-level waste with immobilized plutonium and three canisters of high-level waste without immobilized plutonium can be emplaced.

- Shipment of canisters of DOE SNF is started after the receipt rate for commercial SNF reaches 3,000 MTHM per year. Shipment is not started earlier than 2015. Sufficient quantities of high-level waste without immobilized plutonium are shipped so that waste packages containing one canister of high-enriched DOE SNF and five canisters of high-level waste without immobilized plutonium can be emplaced. DOE SNF that is not high-enrichment is not codisposed with canisters of high-level waste.

- The characteristics of commercial spent fuel and the schedules for reactor shutdown are provided in the 1996 update to the Energy Information Administration (EIA) Service Report (DOE 1996c), projections of future discharges (CRWMS M&O 1996), and recent information regarding early permanent shutdown of reactors.

The following ground rules and assumptions apply to transportation:

- The market-driven strategy described in the draft request for proposal for waste acceptance and transportation services (DOE 1998. *Acquisition of Waste Acceptance and Transportation Services for the Office of Civilian Radioactive Waste Management.* Draft RFP DE-RP01-98RW00320. Washington, D.C.: U.S. Department of Energy, Office of HQ Procurement Operations.) will be used.

- All wastes are shipped to the repository in legal weight truck casks or large casks certified by the NRC. The assumed characteristics of the casks that would be used are described in Appendix B.

- All casks and canisters are assumed to be available when needed.

- Commercial SNF may be placed in dual-purpose canisters (DPCs) either for storage at the reactor site or for temporary storage at the repository. If the purpose of the DPCs is to provide for temporary storage at the repository, the canister costs are included as part of the CRWMS costs.

The following assumptions apply to the Monitored Geologic Repository (MGR):

- Deferral of the start of waste emplacement beyond 2010 was not considered as an option in this study.

- Construction of facilities starts with the NRC construction authorization for the repository in March 2005, consistent with the *Viability Assessment of a Repository at Yucca Mountain* (DOE 1998d, Volume 5, Section 2.2). Construction of deferred modules is to be accomplished without interruption of ongoing waste management operations.

- Facilities that provide early receipt of waste are integrated with the repository facilities that receive waste and prepare it for emplacement in subsurface facilities.

The following assumptions apply to the analysis of effectiveness and required funding:

- The effectiveness of the program implementation scenarios will be characterized by accomplishments through the end of 2020.

- Annual costs are given in year of expenditure dollars to be consistent with current budgeting practice. Escalation through FY2002 is based on the Department of Energy indices (DOE 1996b). Escalation beyond FY2002 is assumed to be the projection provided in *Review of the U.S. Economy, Long-Range Focus* (Standard & Poor's DRI 1998).
- CRWMS total system life cycle costs, utility costs, and societal costs are given in constant dollars to be consistent with the method used for the *Analysis of the Total System Life Cycle Cost of the Civilian Radioactive Waste Management Program* (DOE

1998a, Section 1). For this report, constant 1998 dollars (98$) are used. Estimates of net present value assumed a 2.3 percent discount rate (Standard & Poor's DRI 1998).

- Costs for the reference program implementation scenario are those provided in the *Analysis of the Total System Life Cycle Cost of the Civilian Radioactive Waste Management Program* (DOE 1998a). The costs for other implementation scenarios will be adjustments to the costs for the reference program implementation scenario to reflect differences in approach and scope.

1.2 ORGANIZATION OF THE REPORT

This report describes the modules of the modularized CRWMS, the approach used for formulating and analyzing program implementation scenarios, and the analysis results. The report includes conclusions and recommendations that were drawn from the analysis results.

Section 2 provides a description of the approach. The method is described for the selection of initial facility modules, the schedule for deferred modules, and the rates at which waste is picked up. The analysis of the scenarios includes estimation of eight effectiveness measures. Each of these effectiveness measures is described in this section.

Surface facility modules, are described in Section 3. The modules for the subsurface facility are described in Section 4, and Section 5 discusses the alternatives for Nevada transportation to the repository.

The program implementation scenarios are provided in two sections. The scenarios that start waste receipt in 2010 are described in Section 6, and the scenarios that start early receipt at the repository surface facilities in 2007 or 2008 are described in Section 7. Sections 6 and 7 both include estimates of annual costs, effectiveness, and regulatory impacts and risks.

Conclusions and recommendations are discussed in Section 8.

Acronyms are defined in Appendix A. Appendices B, C, D, and E provide supporting data. Appendix B describes the transportation system that was assumed for shipment of the wastes to Nevada. Appendix C presents supporting details for the costs of scenarios that start waste receipt in 2010. Appendix D provides similar details for scenarios that start early receipt at the repository surface facilities in 2007. Appendix E provides cost details for each of the facility modules. The basis for estimating utility storage costs is also provided in Appendix E.